APPENDIX F
STAFF RESPONSES TO SCIENTIFIC PEER REVIEWER COMMENTS

Basin Plan Amendment for Methylmercury in the Delta
Response to Scientific Peer Review Comments

The June 2006 Delta Mercury TMDL Report and Draft Basin Plan Amendment Staff Report were submitted to two independent scientific peer reviewers in June 2006. The peer reviewers were asked specifically about the linkage between methylmercury in water and fish, staff's calculations of mercury loads, and likely effectiveness of the proposed implementation plan in reducing mercury in fish. They were also asked to comment on any other scientific issues of concern and whether the proposed regulations are based on sound scientific knowledge, methods, and practices.

Dr. Sedlak sent two letters. Dr. Horne's comments are in one letter. The complete letters from the peer reviewers and instructions to the reviewers are available at the Delta TMDL website:
http://www.waterboards.ca.gov/centralvalley/programs/tmdl/deltahg.html#Peer

Staff's summary of each reviewer comment is in bold text and is followed by the staff response.

Dr. David Sedlak, UC Berkeley Dept. Civil and Environmental Engineering Letter Dated 8 August 2006

Comment 1. General Impressions

"Given the complexity of the problem and the difficulties associated with setting goals that are achievable, I believe that the staff members have used the available scientific data in a reasonable manner. Although I have some concerns about specific details, I have not found any major flaws that would call the scientific approach into question"

As Dr. Sedlak detailed his specific concerns in comments that followed, no response is necessary.

Comment 2. Proposed Basin Plan Amendment language pg. 5.

The proposed plan would require that all NPDES-permitted wastewater treatment plants (WWTPs) implement a pollution prevention plan. No scientific evidence is presented to support the idea that these programs will have a measurable effect on methylmercury discharged from WWTPs. Source control will likely reduce mercury in sludge produced in the treatment process, but not in effluent.

Staff recommended that pollution prevention plans be implemented to reduce total mercury discharged from WWTPs, rather than to reduce methylmercury discharges. A goal of the proposed Basin Plan Amendment is to prevent total mercury and methylmercury levels in the Delta from increasing while the methylmercury characterization and control studies are taking place. Pollution prevention plans can have a measurable effect on reducing total mercury in WWTP discharges. For

example, according to recent Sacramento Regional County Sanitation District (SRCSD) information, the SRCSD Sacramento River WWTP has reduced its total mercury discharge between 2000 and 2005 by almost 50%. The California Department of Finance predicts that populations in the Delta and immediately adjoining counties will increase 60-120% by 2030, and 130-200% by 2050. Such population increases are expected to result in similar increases in WWTP effluent volumes and associated total mercury loads. Pollution prevention plans are a cost-effective way to help ensure that WWTPs maintain their discharge mercury levels as low as possible.

In addition, the requirement for WWTPs to implement pollution prevention plans is not new with this proposed Basin Plan Amendment. Section 13263.3 of the California Water Code states, "The Legislature finds and declares that pollution prevention should be the first step in a hierarchy for reducing pollution and managing wastes, and to achieve environmental stewardship for society. The Legislature also finds and declares that pollution prevention is necessary to achieve the federal goal of zero discharge of pollutants into navigable waters." Section 13263.3 also describes the conditions for requiring a pollution prevention plan, one of which is, "The state board, a regional board, or a POTW determines pollution prevention is necessary to achieve a water quality objective." Because the Delta is listed as impaired by mercury on the Clean Water Act Section 303(d) List, Central Valley Water Board NPDES permit staff have included requirements for pollution prevention plans for mercury in recent permits for publicly-owned treatment works that discharge to or upstream of the Delta. Including the requirement for pollution prevention plans in the Basin Plan Amendment is a way to ensure that this practice continues.

Comment 3. Proposed Basin Plan Amendment language Table B.
"Is the percent reduction for the West Sacramento WWTP supposed to be 0% and not 100%?"

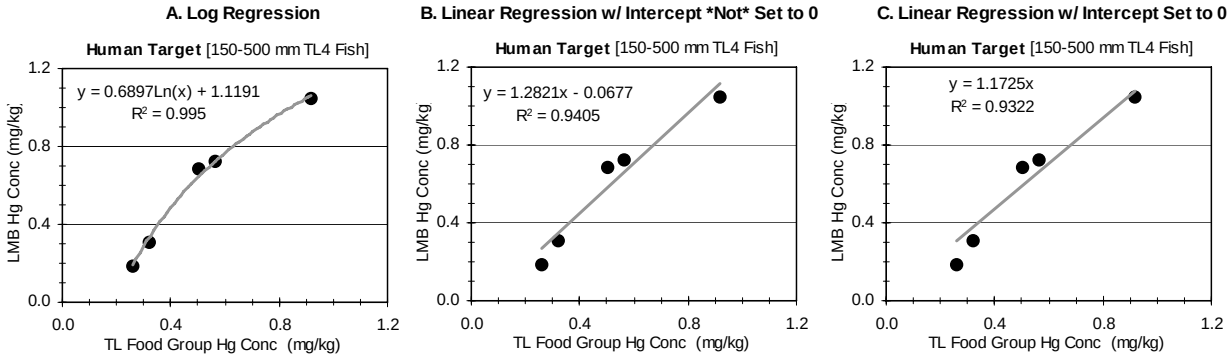
Yes. The percent reduction has been corrected.

Comment 4. TMDL Section 7.4.2 and Table 7.18.
Dr. Sedlak suggests that the staff report describe that elevated aqueous mercury concentrations (above the California Toxics Rule criterion for human health protection) are due to high total suspended solids in high flow events and that drinking water supplies are not threatened by mercury.

Staff agrees with Dr. Sedlak's assessment that drinking water from the Delta is not unsafe due to mercury because most mercury, which is bound to particulates, would be removed in a drinking water treatment process. However, the health standards for mercury were developed to protect humans against exposure to mercury through drinking water and through consuming fish tissue. It is the latter of these two exposure channels that requires lower mercury limits due to the chemical's bioaccumulative effects through the food chain. The analysis was conducted under the stricture of the more protective limit.

Comment 5. TMDL Section 4.8.3 and Figure 4.5. Staff used a linear regression equation forced through the origin to describe the relationship between mercury concentrations in trophic level 4 fish 150-500 mm in length and in largemouth bass. This is in contrast to the equations for relationships between largemouth bass and the other trophic level groups and size classifications, which were logarithmic equations not forced through the origin. There is no basis for forcing one regression through the origin but not the others.

Both logarithmic and linear curves intercept the x-axis above zero for the plot of mercury concentrations in largemouth bass versus the trophic level four 150-500 mm fish. This results in the prediction of near-zero or even negative values for some of the standard largemouth bass mercury concentrations that correspond to the alternative large TL4 fish mercury targets developed for human protection shown in Table 4.5 in the June 2006 report. Staff considered this situation to be a function of the trend lines tested and a lack of data for locations with very low fish mercury concentrations, rather than a true estimation of fish mercury levels. Therefore, a linear equation with the intercept forced to zero was used to estimate standard 350 mm largemouth bass mercury concentrations that correspond to the large TL4 fish target alternatives. All three regressions - logarithmic, linear, and linear with zero-intercept - are statistically significant ($P<0.01$). Staff added text to the TMDL report to better explain the basis for forcing the TL4-LMB regression through zero.



Comment 6. TMDL Section 4.7.2 and Tables 4.2, 4.3, and 4.9.
The safe dietary values for snowy plover are different between these tables. Are the differences due to assumptions about lack of mercury in much of the snowy plover diet, which includes aquatic and terrestrial invertebrates?

Yes. 75% of the snowy plover diet is terrestrial mammal, bird, reptile, and invertebrate prey, which is assumed to contain negligible amounts of methylmercury. These

assumptions are shown in Table 4.1. These parameters for the snowy plover diet were provided by the US Fish and Wildlife Service.[1]

While Table 4.2 indicates safe concentrations of methylmercury in the total diets of various wildlife species, Table 4.3 indicates the safe concentrations of methylmercury in various sizes of fish within these diets. Table 4.9 shows the predicted safe levels in large TL4 fish and standard size largemouth bass that correspond to the safe levels for various wildlife species. Dr. Sedlak is correct that the difference between total diet safe level (0.03 mg/kg, Table 4.2) and safe methylmercury concentration in trophic level 2 prey less than 50 mm (0.10 mg/kg, Table 4.3) is due to the composition of the snowy plover diet. The predicted safe levels in large fish that correspond to a prey concentration of 0.10 mg/kg that are shown in Table 4.9 are correct and come from the regression equations shown in Figures 4.2 and 4.5.

Comment 7. TMDL Section 4.5.3.1.
"I suggest that you show more than one significant figure on the example calculations of safe methylmercury concentrations to protect various wildlife species."

The calculations in Section 4.5.3.1 already use two significant figures for variables used in the equations (food chain multipliers and tropic level) and in the results. To improve clarity, staff added a second significant figure to the diet proportions and to the safe methylmercury concentration in TL3 fish for river otter. For example, 90% of TL3 fish in the diet is now shown in the equations as "0.90" instead of "0.9".

Comment 8.
Davis and Greenfield (2002) is missing from the TMDL reference list.

Staff updated the citation in the text and added the reference to the reference list.

Comment 9.
The proposed Basin Plan Amendment would require that wastewater treatment plants (WWTPs) that discharge to impaired subareas of the Delta reduce methylmercury in their effluent. Industrial users are not subject to the same restrictions because a comparison of intake and outflow data suggests that their activities do not increase methylmercury concentrations. The TMDL should treat the industrial and municipal dischargers in a similar manner. If you apply the same inflow/outflow comparison to WWTPs, then a WWTP that discharges a lower concentration of methylmercury than in its raw source water should be given credit for the decrease.

The five power and heating/cooling facilities in the Delta use ambient water for cooling. Based on the comparison of available intake and outflow methylmercury data (TMDL

[1] USFWS, 2003. Evaluation of the Clean Water Act Section 304(a) Human Health Criterion for Methylmercury: Protectiveness for Threatened and Endangered Wildlife in California. US. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Environmental Contaminants Div. Sacramento, CA.

Section 6.2.3 and TMDL Appendix Table G4), these facilities do not appear to act as a source of new methylmercury to the Delta.

Staff changed the proposed Basin Plan Amendment language to assign aqueous methylmercury allocations to all NPDES-permitted facilities, including power and heating/cooling facilities (Table B of the proposed Basin Plan Amendment). Table 4.6 of the Basin Plan Amendment staff report identifies the various types of facilities (aquaculture, manufacturing, power, publicly owned treatment works, etc) in the Delta.

Dr. Sedlak suggests that a WWTP that discharges less methylmercury than it takes in be given credit for the decrease. In response, staff compared methylmercury concentrations in source water and effluent for various Delta facilities and considered whether credits would be possible under existing policies. At this time, the Regional Board does not have a framework for offering methylmercury discharge credits that could be traded or banked against future expansions. In the proposed Basin Plan Amendment (Table B), many WWTPs discharging directly to the Delta are assigned a zero percent reduction in methylmercury loads, either because they discharge to an unimpaired area of the Delta or because their discharge concentration is less than the aqueous methylmercury goal. Thus a credit would not be needed. Staff will consider credits as a possibility for future policy development with offsets in Phase 2 of the implementation plan, or future TMDLs.

Comment 10. TMDL Section 7.1.4.
The discussion of dry deposition of mercury included the statement, "…mercury may be more or less easily transported than water once it comes in contact with land surfaces." The possibility that mercury could be more easily transported than water does not make a lot of sense. Is this a misstatement?

This was a misstatement. The paragraph has been revised and simplified (pg. 117 in Peer Review TMDL Draft Replacement Chapter 7).

Comment 11.
In Tables 8.3 a-g, I believe that the column headed "Acceptable MeHg concentration" should have units of ng/L and not g/yr.

Staff corrected Tables 8.3a-g.

Comment 12. TMDL Appendix J Regressions of flow versus mercury concentration.
"The conclusion that all of these regressions are significant is questionable. For example, the Feather River graph shows about 30 data points with flows less than 30,000 cfs and three with higher flows. Without the three higher points, I suspect that there would not be a significant relationship (i.e., it would look like a scatter plot). Simple linear regression models assume equal spacing of data and these regressions may be biased by a few high flow observations. It may be necessary

to consult a statistician about the need to weigh the data to avoid bias or to identify other ways to test the significance of putative relationships".

Staff used the available data for calculation of the mercury/TSS to flow relationships. Staff agrees that the R^2 values for the regressions of total mercury versus flow for some tributaries, particularly the Feather River and Colusa Basin Drain, are relatively low. When there were enough data points to be statistically significant, staff preferred to use the regression equations to estimate loads rather than multiplying flow by an average mercury or TSS concentrations. We have attempted to address the issue of fewer points at high flow events by planning the collection of more concentration data at high flows. When available, this data should lead to a more accurate characterization of the rating curves. It is useful to note that this is a TMDL for the Delta. Information on mercury loads from tributaries is provided to help readers understand where the mercury originates and to guide future studies. Newer data will be incorporated in the TMDLs for the tributaries.

Staff consulted with a statistician on staff at the University of California, Davis, for a review of the methods used in calculating mercury and TSS loads and for guidance on calculation of confidence intervals. This information, in the form of revised TMDL Report Chapter 7 and Appendix J, was provided to the scientific peer reviewers several weeks after the initial review package. The UC Davis statistician confirmed staff's use of the regression equations to calculate loads when the regressions were statistically significant.

Tables 7.1, 7.3, 7.4, 7.6b, 7.6c, 12, 14 and 16 in the revised Chapter 7 show the completed 95% confidence intervals for the total mercury and suspended sediment load estimates and for the Delta and Sacramento Basin mass budgets. The method of calculating the confidence intervals is provided in the revised Appendix J.

One purpose of the confidence intervals is to allow staff to determine whether the Delta and Sacramento Basin total mercury and sediment budgets "balance" (i.e., whether there is a statistically significant difference between the inputs and exports) and to formulate recommendations for compliance with the San Francisco Bay mercury TMDL allocation for the Delta. Table 7.14 shows estimates of Delta exports to San Francisco Bay from the TMDL, a separate Central Valley Water Board report, the San Francisco Bay TMDL, and the San Francisco Bay Regional Monitoring Program. For the Delta TMDL, Staff calculated confidence intervals around the TMDL's estimates of mercury exports from the Delta to the San Francisco Bay at X2 and compared these values with estimates by others of mercury exports at Mallard Island. Staff noted that considerable variation is present in the various estimates made for Mallard Island and X2, even for the same six-year period. The confidence intervals for the mercury loads at X2 calculated by staff were broad and overlapped the range for Mallard Island mercury loads provided in the San Francisco Bay Mercury TMDL. Central Valley Water Board staff concluded that unless a consensus is reached on the 20-year mercury export rates at Mallard Island, compliance with the San Francisco Bay mercury allocation to the Central Valley is best determined by monitoring mercury inputs to the Delta.

Dr. Sedlak's Letter Dated 6 September 2006

Comment 1.
"The first scientific question is related to whether available data can be used to accurately determine the contributions of methylmercury from managed wetlands, agricultural runoff, and urban runoff. …The estimates of loading from these three classes of methylmercury sources are based on a very limited data set and have considerable uncertainty. Therefore, I agree with the staff's decision to require the collection of additional data to obtain better estimates of the loading from non-point sources. …To increase the likelihood that the data will be useful to future load estimates I suggest that any additional plans for data collection be subject to peer review."

Staff appreciates the suggestion that plans for the characterization and control studies be subject to peer review. To the extent possible with funding constraints, staff agrees that plans should be peer-reviewed. The Basin Plan amendment now recommends that staff form an independent/external technical advisory committee to review study designs and results. Data collected as part of a CALFED Ecosystem Restoration Program project may be subject to peer review through the CALFED Science program. Furthermore, all future Basin Plan amendments will be subject to the same peer review requirements as this one, as required by Californian Health & Safety Code § 57004.

Comment 2.
"I agree with the staff that there currently is not enough information to design effective control strategies or to estimate the costs of such strategies. …At this point, it is difficult to know if methylmercury production really can be minimized by wetland designs. …Without additional research, it seems likely that the only control strategy for methylmercury in restored wetlands would be not to restore wetlands. If this is the effect of requiring that restored wetlands do not increase methylmercury loadings, I believe that this decision should be made in light of the benefits to the ecosystem associated with habitat restoration."

The proposed methylmercury control program does not require any methylmercury reductions from restored wetlands during the Phase 1 characterization and control study period. Recent studies reported at the 2006 CALFED Science Conference (http://science.calwater.ca.gov/conferences/sciconf_index.shtml) suggest that different types of wetland habitats produce varying amounts of methylmercury. The proposed Basin Plan Amendment recommends that any new information be incorporated into new wetland and restoration projects.

Comment 3.
"I agree with the staff that the planned collection of data on methylmercury concentrations in agricultural drains and [storm water] runoff will be useful to establish a mass balance. However, I am uncertain that cost-effective

approaches for reducing methylmercury concentrations will be developed during the study period. It is likely that any approaches that are developed will be limited to specific types of soils and crops, thereby necessitating site-specific studies prior to selection of control approaches. Likewise, quantification of mercury and methylmercury in storm water is likely to be challenging due to the potential for sample contamination and the variability of flows within storms.

Comment 4.
"In conclusion, I believe that the staff has employed a sound approach to implementing the TMDL in a stepwise fashion that is consistent with the principles of adaptive management, which was recommended by the National Academies in their review of the TMDL process. After completion of the studies it is likely that the staff will be in a better position to assess methylmercury loading and the costs associated with control activities. However, the estimates of methylmercury loads from these sources and the cost effectiveness of various control strategies will always have considerable uncertainty.

No further response is necessary. Staff thanks the reviewer for his comments.

Alex Horne, UC Berkeley Professor Emeritus, Ecological Engineering, Dept. Civil & Environmental Engineering

Comment 1. Loss of Delta Habitat.
"The overriding ecological need in the Delta is to restore as much habitat as possible to its original tidal wetland state. …Although the restoration of the Delta is not the Board's main responsibility, in its MeHg TMDL addendums proposal the single-minded pursuit of mercury control threatens Delta restoration. In effect, the TMDL will throw the baby (the Delta) out with the bathwater (excess MeHg)." Because sources of inorganic mercury from the Coast Range, Sierra streams, and atmospheric deposition are unlikely to be reduced very much in the next 50 years, excess methylmercury will continue to be produced in wetlands. Restoration of wetlands will be effectively prevented because the Board has not guaranteed that adequate offsets will be available to be used by wetlands projects.

The reviewer does not agree with the proposed implementation plan because the reviewer believes that regulation of mercury is of secondary importance compared to wetlands restoration. Dr. Horne suggests that the regional staff table the mercury TMDL project and instead devote their resources to wetlands restoration. However, the regional board is committed to reducing the levels of toxic MeHg through the TMDL process to address the continued impairment of the Delta water system.

The reviewer recognizes that wetlands are noteworthy sources of methylmercury and is concerned that this characteristic might hamper future wetlands restoration projects if the draft Basin Plan is adopted. Staff realizes that more information is needed about effective ways to control methylmercury from various sources, including wetlands. Staff proposes that dischargers specifically not be required to meet the methylmercury allocations until the proposed Characterization and Control Studies are completed. At the end of the study period, the Central Valley Water Board would review any new information and adjust the program of implementation, including methylmercury allocations, as necessary.

Concern with methylmercury and wetlands restoration projects in the Delta is not new. The CALFED Water Quality Program Plan (July 2000) calls for monitoring of mercury and methylmercury during and after remediation and development of remediation options that address mercury loading, transport, transformation, or bioavailability. This CALFED plan also states that an ultimate goal should be the lifting of fish tissue advisories and the elimination of the need for new ones. The CALFED Bay-Delta Program Record of Decision (ROD) preferred option includes significant restoration of wetlands in the Delta. The ROD Appendix A, "Mitigation Measures Adopted in the Record of Decision" (August 28, 2000), describes potentially significant environmental impacts resulting from adoption of the preferred Plan, including an increase in methylation of mercury in constructed shallow-water habitat. The CALFED ROD Appendix A also describes mitigation measures to reduce potential effects of

implementation of the Preferred Program Alternative on water quality, including "test for mercury in soils and locate constructed shallow-water habitat away from sources of mercury until methods for reducing mercury in water and sediments are implemented." The California Environmental Quality Act Findings of Fact contained with the CALFED ROD (ROD Attachment 1, August 28, 2000) state, "The bioaccumulation of toxic methyl mercury in food webs can impact consumers of aquatic organisms, specifically through the consumption of fish caught in the Bay-Delta. This impact is considered significant." Probably not all Delta wetland restoration projects will be performed under the CALFED program. However, those that are planned under CALFED need to consider the impact methylmercury, even without the Delta TMDL.

The reviewer is concerned that the Central Valley Water Board has not guaranteed that adequate offsets will be available. In the proposed Basin Plan Amendment language, staff strengthened the Board's commitment to consider offset pilot projects and lengthened time for developing an offset program. The proposed Amendment includes the following:

> By [8 years after adoption of the Amendment], the Regional Board intends to consider adoption of an offset program to allow dischargers to offset methylmercury and/or total mercury in their discharges by implementing more feasible or cost effective projects elsewhere in the watershed. The offset program will be consistent with any State Board offset policy that is developed. In the interim, the Regional Board will allow all mercury and/or methylmercury dischargers to conduct pilot offset projects. The pilot offset projects could achieve one or more of several goals: accomplish early implementation of mercury reduction projects; provide information that can be used to develop the Phase 2 offset program; and/or earn credit to offset methylmercury allocation and/or total mercury limit requirements during Phase 2 of the Project. To be most useful, the pilot offset projects should focus on projects that can be implemented relatively quickly.

"The obvious scientific solution is to balance the potential harm of MeHg production in wetlands with the certain large ecological benefit of these wetlands. Urgently needed is a trade (offset) between wetlands restoration benefits and MeHg production. The Board only offsets like with like (i.e., not mercury with, for example, increase in habitat area.) It is not sound science to restrict the certain benefits of restoration of the Delta for possible harm caused by low levels of MeHg."

The federal Clean Water Act requires that States list water bodies that do not meet water quality standards (i.e., are impaired) and develop programs to correct the impairment. Federal law does not give the State license to allow the methylmercury impairment to remain or worsen in trade for other environmental improvements. The overall requirement of reducing methylmercury is thus established. However, the Central Valley Water Board does have flexibility in deciding how the methylmercury reductions will be achieved. If presented with convincing evidence that lack of or delay in restoration of wetlands causes harm to habitat or sensitive wildlife species, the Board

could adjust the allocation scheme. Staff agrees that there needs to be a balance between reducing methylmercury produced by wetlands and protecting ecological benefits provided by wetlands.

Dr. Horne describes the levels of methylmercury in the Delta as "low". However, there is a consumption advisory regarding eating sturgeon and striped bass from the Delta. The California Office of Environmental Health Hazard Assessment recently released a draft of safe eating guidelines for other Delta fish species. In surveys of consumers of Delta fish, the Department of Health Services Environmental Health Investigations Branch has found that people routinely eat Delta fish, of these and other species, in excess of the safe human intake level of methylmercury (USEPA's methylmercury reference dose). Thus far in wetlands restoration, there has been little attention given to methylmercury production. While ecological and human benefits of wetlands are being realized, the human health risk of methylmercury must not be ignored and should be minimized. In addition, methylmercury risks to Delta wildlife are still presumed to occur. Although Delta-specific exposure and effect studies for wildlife are lacking, concentrations of methylmercury measured in Delta fish are above levels observed in field and laboratory studies elsewhere that harm wildlife species.

Comment 2. Arbitrary decisions.
"Not enough is understood about the environmental chemistry of mercury in the Delta to make informed scientific decisions (for example what controls MeHg in wetlands). …In the work of my own group at UC Berkeley we have found that iron and redox are also important (these factors are not considered in the TMDL documents provided suggesting 3b errors and incomplete rather than unsound science)."

Staff's intention in Chapter 3 was to highlight factors important in methylmercury production that are potentially controllable in the Delta, which included sulfate, new water impoundments and wetlands, and inorganic mercury. Staff recognizes that other factors, including pH, iron, activity of methylating bacteria (iron-reducing or sulfate-reducing), percent and type of organic material, and redox state can also affect methylmercury production. These factors were not considered controllable in the Delta and were not discussed in detail. Staff appreciates the suggestion to include iron and redox in the discussion of factors affecting mercury methylation.

"My view is that making detailed plans for allocations of MeHg loads are thus premature until more is known about how to construct large seasonal and permanent wetlands that do not produce very much MeHg. More logical at this time would be an attack on the known main sources that are understood (old mines, sediment from these mines, other external sources) since the chemistry and hydraulics of these large sources is known."

Staff agrees that more information is needed about design and operation of wetlands that minimize net methylmercury production or export. That is why staff proposes that dischargers not be required to meet methylmercury allocations until further studies are

completed. It may seem premature, then, to include methylmercury allocations in the proposed Basin Plan Amendment. However, federal regulations require that a TMDL include wasteload allocations for point sources and load allocations for nonpoint sources. Staff changed the proposed Basin Plan language to make it clear that the Central Valley Water Board intends to reevaluate the allocations and program of implementation after the characterization and control studies are completed. The allocations will guide the characterization and control studies, in terms of identifying subareas that need the greatest reductions and thus effort toward developing management practices. Nonpoint and point source dischargers will be involved in determining where characterization and control studies should occur and will have primary responsibility for developing study work plans.

Staff also agrees that sources of inorganic mercury, which are mainly upstream of the Delta, should be addressed in order for a control program to be effective. These sources are not ignored. The proposed Basin Plan Amendment assigns a total mercury load reduction to Cache Creek exports and requires improvements in the trapping efficiency of the Cache Creek Settling Basin. Cache Creek contributes about 30% of the mercury load from the entire Sacramento River Basin. The proposed Basin Plan Amendment also requires controls on mercury from point sources (wastewater treatment facilities and storm water systems) that discharge to the Sacramento River, San Joaquin River, and other tributaries downstream of major dams. These waters are the focus of the next set of TMDLs to be developed by the Central Valley Water Board, which will assign additional total mercury load reductions.

Mercury reductions upstream are also being accomplished separately from the Delta TMDL. For example, the Cache Creek Watershed TMDL required that 14 inactive mines be remediated to pre-mining conditions with respect to mercury discharges. Under an emergency response action, the USEPA is currently directing the cleanup of the two largest of those mines, which are on Harley Gulch. The USBLM, the USFS, and the USEPA have brought about cleanups at several sites highly contaminated with mercury in the Bear and Yuba River watersheds, including Polar Star, Sailor Flat, and the Boston Placer Mine. State Water Board staff has performed a pilot project that removed elemental mercury by suction dredging at an in-channel “hot spot” in the American River. As described in the TMDL report, though, mercury is nearly ubiquitous in tributaries that hosted mercury or gold mining. Cleaning up hundreds of sites where mercury was mined or used is a lengthy process. It will take even longer for mercury that has become distributed in streambeds and banks to be removed.

Comment 3. Mass Balance Concerns. The main strategy of the Board for all but the smallest entities is to offset any of their MeHg in other Delta areas. This provision is important for large, uncontrolled wetlands, such as Yolo Bypass wetlands. As more such large wetlands are restored in the Delta, it is not clear that there is sufficient offset available. If non-similar offsets were allowed (Comment 1), this would not be a concern.

Staff agrees that as more wetlands are restored, there may not be sufficient methylmercury reductions being achieved elsewhere to offset the increased methylmercury loads coming from new wetland projects. This dilemma emphasizes the need for more studies on how to control methylmercury and attention to design and timing of new projects so that methylmercury from new projects is controlled.

Staff proposes a mercury management strategy that relies first on a study period that will refine the estimates of methylmercury loads and test possible management practices. Identification of management or land use practices that can limit net methylmercury production will aid in identifying possible offset projects.

The peer review version (June 2006) of the proposed Amendment stated that staff would develop a mercury offset program for Central Valley Water Board consideration in 2009, which is a relatively short time for identification of possible offsets. Staff adjusted the proposed Basin Plan Amendment language to make it clear that the implementation plan, including allocations, will be reconsidered after the study period. The revised Amendment proposal states that an offset program will be proposed at the end of the study period and allows dischargers to participate in a pilot offset program, if desired, until a full offset program is developed. Offsets are just one tool for addressing "uncontrollable" methylmercury from wetlands. Timelines and allocations to other sources may also be adjusted to enable increased wetland methylmercury loads. However, if gradual reduction in total mercury concentration of incoming sediment is considered the only feasible method of controlling a wetland methylmercury load, then the timeline to meeting the allocation would be lengthened, prolonging the methylmercury risk to humans and wildlife. Note that the State Water Board remanded the San Francisco Bay mercury TMDL to the San Francisco Bay Water Board for further consideration in part to accelerate achievement of fish tissue objectives for mercury in the Bay.

Again, staff agrees with the need to balance benefits and disadvantages of wetlands restoration. Staff's responses describe ways this can be done. A formal offset program that addresses both methylmercury loads and ecological benefits, though, is complicated to design and implement. An offset program should have a clear, quantitative method for evaluating the items to be traded. Staff expects that it would be very complex for stakeholders, the Central Valley Water Board, and other agencies that must approve an offset program, to agree upon a method for trading non-similar outcomes, such as increased methylmercury in fish eaten by one wildlife species allowed in trade for increased habitat for another.

Comment 4. Unethical Scientific Practices.
In a work this large, unethical scientific practices are likely and are normally easily corrected. "In this report, the usual POBs (positive operator bias) occurred in terms of always choosing the most conservative value rather than a mean or representative values. …[T]he assumption that 100% Hg in fish is MeHg for purposes of monitoring rather than the average of 85-100% as was found in the data is one example of POB. The 3b errors [errors of omission or 'cherry-picking

data'] are harder to detect but the mitigating effects of Se on MeHg toxicity and the lack of evidence of MeHg toxic effects in currently high MeHg areas are two examples."

In the technical analyses and proposed implementation plan, Staff endeavored to take an approach supported by the science and did not purposely select the most conservative value or approach. Staff responded to the examples cited by Dr. Horne.

1) Percentage of methylmercury in fish. The fish tissue objectives are for concentration of methylmercury in fish tissue. The proposed Basin Plan Amendment does state that, "total mercury may be analyzed instead of methylmercury". This is commonly done in fish issue monitoring programs for water quality investigations and consumption guidance to reduce cost of analyses. Because the methylmercury/total mercury ratio in some fish is essentially 100%, it would not be appropriate to apply a corrective factor to the fish tissue concentration used in the linkage analysis (the linkage analysis relationship sets the aqueous goal, from which the allocations are determined). If there is uncertainty or concern about the methylmercury/total mercury ratio when the Delta fish tissue objectives are close to being attained, the Central Valley Water Board could require fish samples be analyzed for methylmercury instead of total mercury.

2). Selenium. No error was perpetrated by not mentioning the sometimes-protective effect of selenium (Se) on methylmercury toxicity. Staff has no evidence that Se that occurs naturally in the Delta is protective for humans eating fish. Staff agrees that studies with wildlife exposed to Se and methylmercury have shown mitigating or protective effects of Se. However, not all studies show Se to be beneficial.

3). Lack of data. The absence of data in the TMDL report showing adverse effects of methylmercury where concentrations are high is not an example of "cherry-picking data". Although highly desirable, studies of effects of methylmercury exposure have not been conducted in the Delta. The Numeric Target section of the Delta TMDL report briefly describes toxic effects of methylmercury observed elsewhere. More information is available in the TMDL report citations and the Clear Lake Mercury TMDL Numeric Target Report (available at: http://www.waterboards.ca.gov/centralvalley/programs/tmdl/clearlake.html). The Department of Health Sciences Environmental Health Investigations Branch has documented high rates of fish consumption by some people in the Delta, which very likely puts them over safe methylmercury intake levels. Verifications of their exposure through biomonitoring and effects studies have not been completed. At the Fall 2006 CALFED Science conference, researchers from the USFWS and USGS presented data about bird populations in San Francisco Bay adversely affected by methylmercury (Woo, Takekawa, and Tsao-Melcer on black rails; and Ackerman, Eagles-Smith, Adelsbach, and Yee on Forsters' terns; Abstracts available at: http://science.calwater.ca.gov/conferences/sciconf_abstract.shtml). If data for humans or wildlife that consume Delta fish become available, staff will incorporate them into the implementation plan.

"The main unethical problems do not appear to be the work of the Board's staff but in the work on which they have relied, especially the mercury toxicity studies of the USFWS (the key to the entire Board calculations appears to be a study on mink and mercury carried out by the USFWS to establish a baseline for mercury concentration vs. health effects). I have not reviewed this secondary work here since it was not in the mandate. However, in my reviews of this agency's work in the past I have found that the USFWS does not have a policy to remove Positive Operator Bias and type 3b errors which are thus often rife.… if [the USFWS] work could be validated by a more reliable non-agency study I would feel more comfortable about the compromise that would be made if a lower Hg standard was applied to the Delta."

Dr. Horne's observations of unethical scientific practices in USFWS work in other fields cause him to question the methylmercury safe levels for wildlife. Staff used these levels in its evaluation of fish tissue objective alternatives. Staff has two responses.

1). The recommended methylmercury fish tissue objectives for large fish are the levels needed to protect people eating eight ounces uncooked Delta fish per week. These recommended objectives are lower than the protective values for wildlife eating large fish (otter, bald eagle, and osprey). Although Staff recommends a small fish objective that is based completely on wildlife needs, the aqueous methylmercury level needed to reach the large fish human-health objective is lower than the aqueous methylmercury level needed to reach the small fish objective. Thus, human safe levels, not wildlife, drive the methylmercury allocations. The Delta TMDL Report Table 4.9 shows all of the wildlife and human health safe fish tissue levels and the corresponding values in terms of the 150-500 mm trophic level 4 fish concentration average and the standard 350 mm largemouth bass concentration. Wildlife safe methylmercury levels are less stringent than levels needed for human consumption of 8 ounces of Delta fish per week.

2). The wildlife toxicity studies, reference dose, and the methodology used by the USFWS to calculate safe methylmercury levels in aquatic prey are published in the USFWS' evaluation of the USEPA's methylmercury human health criterion. This USFWS report was peer reviewed by external, independent scientists. The independent reviewers supported the USFWS' selection of toxicity studies, reference doses, and methodology. The USFWS report and its external review are available at: http://www.fws.gov/sacramento/ec/bio-monitoring.htm.

Staff also notes that the studies upon which the mammalian and avian references doses were based (studies in mink and mallards, respectively) were conducted by researchers not associated with the USFWS and were published in peer reviewed, scientific journals.

Comment 5. Fossilized standards.
"The report is written as if future flexibility can occur in standards. This is not likely and has become a huge flaw in the scientific part of the standard setting mechanism in California and the US as a whole. …Compromises [of making

decisions on available data that may change] are inevitable but experience has taught us that it is virtually impossible to modify standards or Basin Plan Objectives even if the future scientific evidence is overwhelmingly in favor of changes. Although the understanding of copper toxicity in San Francisco Bay changed, water quality objectives there remained for more than 25 years. Will this happen with methylmercury in the Delta? The emphasis on the wrong toxicant or form of toxicant has considerable ecological costs since funds wasted could be spent on real toxicity problems or habitat improvements."

Staff agrees that changing fish tissue objectives or other Basin Plan components can be a difficult or lengthy process. Uncertainty about how best to control methylmercury is exactly why Staff recommends a study period and reevaluation of all Basin Plan components before modifying the control program. As described in the response to Comment 1, the proposed Basin Plan Amendment commits the Board to this reevaluation, including changes to allocations if data support the changes.

Comment 6. A New Paradigm for Pollutant Trading
This comment elaborates on the idea of using unlike currency in a methylmercury offset program. For example, the Yolo Bypass and other wetlands to be created to restore the original Delta are a large environmental good. Farms also are a social good. Both wetlands and farms may increase methylmercury. To remove these wetlands or farms or require them to pay for mercury cleanup upstream is bad for the Delta. The Board must use science to balance the good of wetlands or farms against the harm of methylmercury production. Dr. Horne describes a trading system that he suggested to the Santa Ana Regional Board of allowing some increase in nitrogen and phosphorous loads in Lake Elsinore for increasing the water level during dry periods.

Dr. Horne is concerned that by focusing on methylmercury reduction, that Delta restoration and farming will be harmed. Staff agrees that this is a valid concern. The proposed Basin Plan Amendment does not suggest that farms or wetlands be removed. Staff also agreed with his statement that the Board must use good science in making its decisions. To this end, Staff has endeavored to provide as scientifically valid an assessment of the methylmercury concerns as possible. In order to consider trading habitat for methylmercury reduction, studies must be completed that conclusively show that wildlife species using the habitat are not harmed by the methylmercury. Such effects studies are lacking for the Delta. Please see response to Comment 3 for other thoughts about offsets.

Detailed Comment A. The Water Quality Objective Option #4 is chosen.
"As described elsewhere any option that reduces the likelihood of the recreation of tidal and other wetlands in the Delta is self defeating. The wildlife may be totally free of possibly toxic methylmercury, but that will not matter. There will be no wildlife to save. The reality is that several million of the 20 million more Californians that will be in the state in 2050 will live in and around the Delta. Without a lot of larger new wetlands the wildlife will vanish. Thus the MeHg

standard should take note of the changed environment. Suggestion. Go with the No Action alternative at this time with provision to reduce the Cache Creek and upstream mercury. Intensify research on how to run wetlands to give lower MeHg outputs."

Staff's response has several parts. First, fish tissue objective alternative 4 is not yet chosen. The peer reviewer read Staff's recommendations. The Central Valley Water Board will make its decision at a public hearing. Second, the fish tissue objectives must be protective of the uses of the water to which they are applied. In this case, they must protect wildlife and humans consuming Delta fish by using the best available science for determining the safe levels. Issues like cost and future population pressures in the Delta are not priorities in the objective setting process. Third, the flexibility that Dr. Horne seems to request lies in the implementation plan choices. The draft Basin Plan Amendment Staff Report describes many implementation considerations and options, ranging from whether the plan should address methylmercury as comprehensively as possible by including wetland and farm sources or whether it should rely only on total mercury and take many more generations to achieve safe fish levels in the Delta. Even the California Bay-Delta Authority, which is funding much of the Delta restoration, identified methylmercury as a potentially significant impact that should be mitigated and has called for studies (see response to Comment 1). Staff deemed it worthwhile to call for methylmercury reduction studies from all source categories before determining at the end of the Implementation Phase 1 review period that methylmercury reductions are too costly or infeasible. Provisions to reduce total mercury loading, including from the Cache Creek Settling Basin, are included in the proposed implementation plan. Fourth, the reviewer comments on the Delta's future, both in terms of effects of the proposed methylmercury Basin Plan Amendment and planning for expected population increases. Staff fully agrees that both should balance habitat and protection of Delta wildlife.

Detailed Comment B. Anoxia (redox) in the sediments as a cause of methylation. "I was surprised that anoxia was not considered in the conditions controlling MeHg production. Since the addition of oxygen even at levels of 0.1 mg/L is an experimentally demonstrated method to prevent methylation it is obviously of concern in the Delta. It is also a potentially controllable situation in some areas including wetlands that are so important in in-Delta MeHg production. Oxygenation of water is a simple and inexpensive process and can be increased in wetlands by the choice of plants and hydroperiod. Suggestion: Add the role of oxygen to the appropriate section and consider solution to methylation in Delta habitats at risk."

Thank you for the suggestion to add a discussion about oxygenation to the report. See also response to Comment 2. Through Proposition 40 bonds, the State Water Resources Control Board recently funded the Department of Fish and Game Moss Landing Marine Laboratory and the US Geological Survey to conduct an in-depth study of methylmercury production in seasonal and permanent wetlands and rice fields in the Yolo Bypass. The study will include comparisons of plant effects on methylmercury.

When talking to proponents about management practice studies and pilot projects, staff will discuss plant selection, oxygenation, and wetland flow regime as variables that could be evaluated.

Detailed Comment C. "Piscivorous fish are assumed to obtain all aquatic prey from the local water body so no relative source contributions are used. Unless I have misunderstood the sense or the report, this is an example of positive operator bias (POB) and possible type 3b ethical error ("cherry-picking). The POB is that most birds move over days and seasonally. They may feed on MeHg contaminated food one day and uncontaminated food on the next. This kind of migration bedevils field toxicity studies by must be accounted for. The possible 3b error is that these feeding studies are very likely to be available elsewhere suggesting cherry picking of the data to support lower Hg standards than scientifically justified."

Please see response to comment 4. The wildlife safe methylmercury levels do not drive the proposed fish tissue objectives or the aqueous methylmercury goal. Therefore, even if the wildlife safe levels were higher to take into account a relative source contribution, the recommended implementation plan and allocations would not change. As the reviewer noted, the recommended fish tissue objectives do not even fully protect human Delta residents who consume large amounts of locally caught fish (Dr. Horne's original letter page 3 comment 5 line 7). The implementation plan aside, Staff agrees that it would be useful to be able to fully estimate a migratory bird's methylmercury intake. This is a complex task. Although type of prey information is often available, one also needs the consumption rates by season or stage of life cycle (e.g., is the bird increasing intake in preparation for migration?), body weights, methylmercury concentrations in the prey, and methylmercury excretion rates by life stage (e.g., how much is the bird depurating into eggs or feathers?). In six years of work on methylmercury targets, Staff has not seen this kind of detailed analysis advanced for any wildlife species.

Detailed Comment D. USFWS guidance to the Regional Board on exposure parameters. "This reviewer is not privy to these guidance parameters but past experience with the USFWS in the Central Valley indicated that POB and type 3b errors are common in USFWS reports. Sound science cannot operate in the opaque conditions."

Please see response to Comment 4.

Detailed Comment E. Dilution of MeHg with increased biomass. "In a recent MeHg project in which I was involved (Lake Onondaga, New York), the restoration of the biota was considered to dilute the available MeHg. The situation is the same in the Delta. The Hg inputs are constant or declining. Thus if more wetland and more wetlands biota are created the MeHg/individual will decline. In addition, some Hg may be stored permanently in deeper sediments of the wetlands where it is biologically unavailable. Suggestion: Calculate the dilution and use the

factor obtained to monitor the biota to determine if the proposed standards can be lessened."

Staff is familiar with the idea that an increase in phytoplankton occurring with a static amount of methylmercury will dilute the concentration per unit of plankton, which will reduce the amount of methylmercury eaten per unit prey through the food web. The much larger, diverse Delta, however, may not act like Lake Onondaga. It is staff's understanding that restoration of some wetlands will involve seasonal or permanent flooding of land that has been not flooded since the advent of agriculture and development in the Delta. Flooding of land that is not currently inundated will most likely increase the methylmercury load to the Delta. It is difficult to predict whether an increase in biota from restored habitat will dilute the increased methylmercury. Research by Central Valley Water Board Staff has shown that wetlands can have concentrations of methylmercury 1-2 orders of magnitude higher than adjacent drainage ditches or open water. In contrast, some wetlands, particularly tidally-influenced ones, have little effect on methylmercury loads in downstream water (See CALFED 2006 Science conference abstracts by J. Fleck and M. Stephenson, available at: http://science.calwater.ca.gov/conferences/sciconf_abstract.shtml). Increased biota might have a diluting effect in the Delta, but it is too early to assume that it will occur.

Staff thanks the reviewer for his comments.